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Water-Quality Assessment of the Ozark Plateaus Study Unit, Arkansas, Kansas, Missouri, and Oklahoma—Nutrients, Bacteria, Organic Carbon, and Suspended Sediment in Surface Water, 1993–95

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concentrations occurred between small and medium basins with forest or agricultural land use in either the Springfield or Salem Plateaus or between any of the streams in forest basins in the Boston Mountains, Springfield Plateau, or Salem Plateau (median of less than 0.01 mg/L for all forest basins). As with dissolved nitrite plus nitrate, differences in total phosphorus concentrations occurred between streams draining basins with agricultural land use in the Springfield Plateau and those in the Salem Plateau (fig. 11). Streams in both small and medium agricultural basins in the Springfield Plateau (median of 0.04 mg/L for site 17, 0.05 mg/L for site 19, and 0.08 mg/L for site 4) had larger concentrations than their counterparts in the Salem Plateau (median of 0.02 mg/L for site 35 and 0.03 mg/L for site 38), again indicating a relation to the type of agricultural land use rather than the percent agricultural land use. The largest total phosphorus concentrations were observed at site 16, Kings River near Berryville, Arkansas, which is located about 10 mi (miles) downstream from a municipal wastewater-treatment discharge.

The total phosphorus data collected at 13 fixed sites and 29 synoptic sites during the synoptic sampling in May 1994 and 1995 and August or September 1994 are compared in figure 12. Overall, the data for streams in basins of similar size and land-use setting group together, although the variation in concentrations is greater than with dissolved nitrite plus nitrate concentrations (fig. 7). Many of the exceptions (for example, sites 11, 17, 35, and 37) appear to be discharge related (fig. 13). For example, the May 1995 sample collected at site 37, representing medium, Salem Plateau agricultural basins, had a much larger total phosphorus concentration than other samples from comparable sites (sites 13, 34, 38, and 43). The stream discharge for the May 1995 sample collected at site 37 (fig. 13) was an order of magnitude larger than the discharges at the other sites.

In streams primarily affected by nonpoint sources of phosphorus (primarily agricultural sites), the largest total phosphorus concentrations did not necessarily occur during periods of increased runoff in May 1994 and 1995 but often were measured in the low-flow samples collected in August or September of 1994 (fig. 12). At the two sites representing medium, Springfield Plateau urban basins (sites 24 and 27), the largest concentrations were observed in the August and September samples as expected. The same is true at site 16, Kings River near Berryville, Arkansas, which is downstream from a point-source discharge. The variation among sites primarily affected by nonpoint sources may be attributed to the relation between phosphorus concentrations and discharge. Because phosphorus species tend to sorb to sediments, total phosphorus concentrations decrease with initial increases in streamflow until sediment is mobilized causing an increase in total phosphorus concentrations (fig. 14). Depending on when a sample is collected in relation to the streamflow hydrograph, a larger discharge may have a smaller or larger total phosphorus concentration.

Total phosphorus concentrations also increase with increasing percent agricultural land use. A plot of total phosphorus versus percent agricultural land use is shown in figure 15 for 13 fixed sites and the 29 synoptic sites. The relation of total phosphorus to percent agricultural land use has a positive correlation (Spearman correlation coefficient of 0.74), with percent agricultural land use accounting for about 42 percent of the variation in the total phosphorus concentrations (multiple R^2 of 0.42).

Fecal Indicator Bacteria

Fecal indicator bacteria are measures of the sanitary quality of water. The concentration of these bacteria is one indicator of whether water is safe for whole-body-contact recreation, safe for consumption, or free from disease-causing organisms. Indicator bacteria are not typically disease causing but are correlated to the presence of water-borne pathogens. Sources of fecal indicator bacteria include undisinfected municipal wastewater-treatment effluents; combined-sewer overflows; septic tanks; animal wastes from feedlots, barnyards, and pastures; manure application areas; and stormwater. The fecal indicator bacteria species used in this study are bacteria of the fecal coliform and fecal streptococci groups and *Escherichia coli* (*E. coli*), all of which are restricted to the intestinal tracts of warm-blooded animals. *E. coli* is strictly an inhabitant of the gastrointestinal tract of warm-blooded animals and its presence in water is direct evidence of fecal contamination from warm-blooded animals and the possible presence of pathogens (Dufour, 1977). The fecal coliform test is not as specific for fecal coliform bacteria but tends to test positive for soil bacteria as well.